



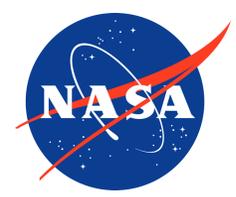
Stratospheric Aerosol and Gas Experiment III/ISS – Mission Status



**David Flittner,
SAGE III/ISS Mission Team
& SAGE III/ISS**

12-13 September 2023

sage.larc.nasa.gov



Outline



- **Accomplishments of note since last year**
- **Senior Review Themes**
- **Budget**
- **Future**

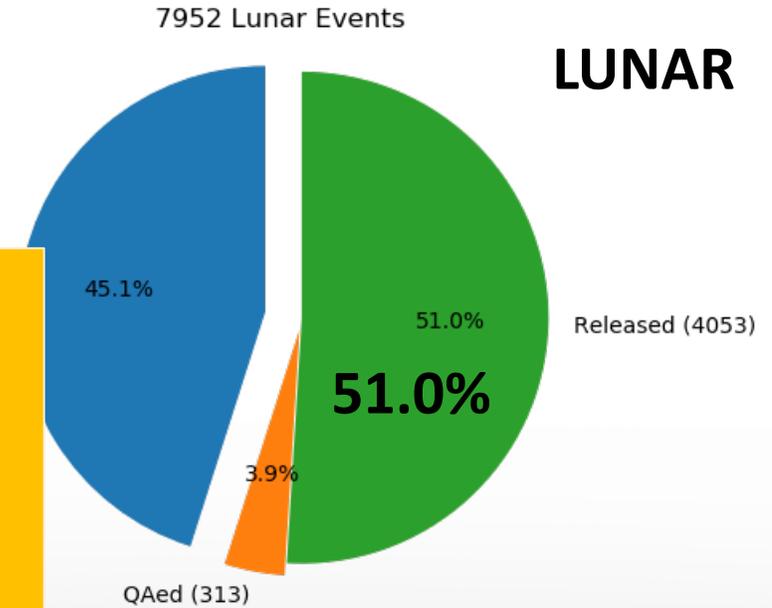
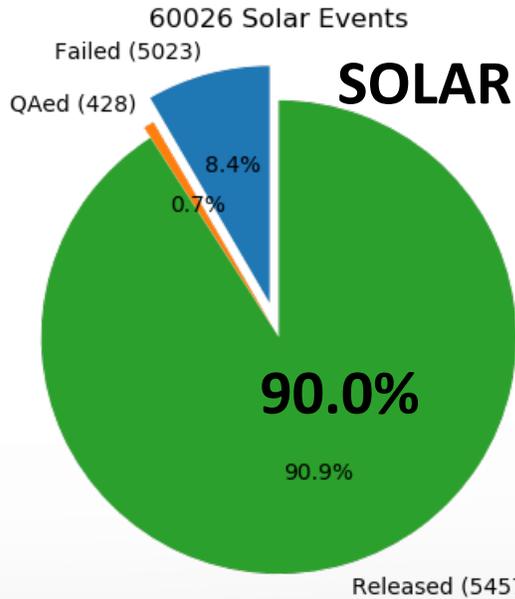




Science Data Collection in v05.30: Whole Mission



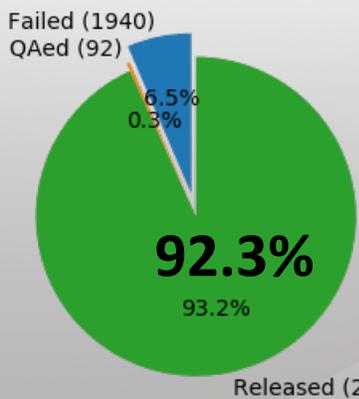
20170531
through
20230731



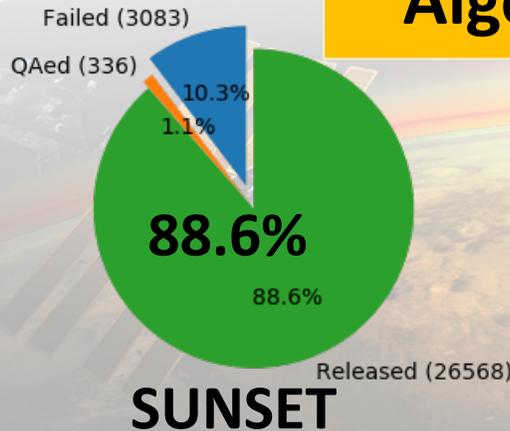
See presentations
by:

- Jamie Nehrir:
Operations
- Robbie Manion:
Algorithm

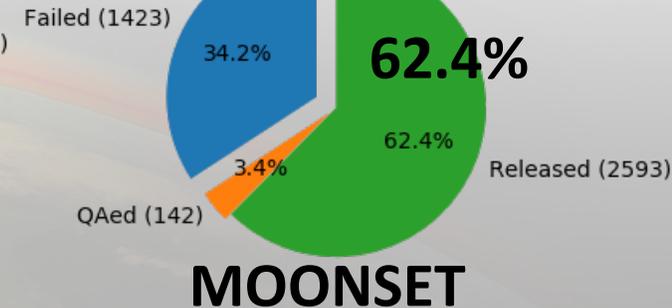
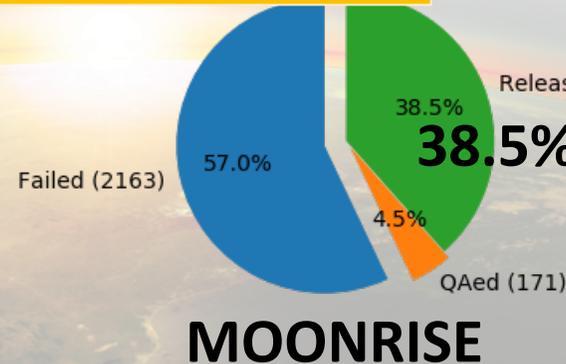
30039 SR Events
SUNRISE



29987 SS Events



4158 MS Events





v5.3



➤ v5.3 Level 1 & 2 released February 2023

- v5.2 still available through Jan. 31, 2023
- See Manion for more details

➤ Gather single event granules into a “monthly” file (netcdf)

- Same content as single event files, but for ~ month
 - NEW! Month = a true month
 - Thanks to Emma Knowland and the MERRA2 processing team for modifying the MERRA2 monthly release to include the first day of the following month, i.e. July 2023 included August 1, 2023.
- Available via Atmospheric Science Data Center ([ASDC](#))

Table 2: SAGE III/ISS data products. The source of all product algorithms is mission Data and Analysis. The vertical range is often limited by cloud top height.

Profile Data Product	Status*	Units	Vertical Range (km)	Mid/Lower Stratospheric Precision (%)	Product Residence
Transmission Slant Path Transmission	Provisional	None	0-100	0.05	Level 1B Transmission
Aerosol (9 Wavelengths) Extinction Coefficient	Validated Stage 1	km ⁻¹	0-45	8	Level 2 Solar
Ozone (MLR) Concentration	Validated Stage 2	cm ⁻³	0-70	5	Level 2 Solar
Ozone (AO3) Concentration	Validated Stage 2	cm ⁻³	0-70	5	Level 2 Solar
Ozone (Mesospheric) Concentration	Provisional	cm ⁻³	50-100	15	Level 2 Solar
Nitrogen Dioxide Concentration	Validated Stage 2	cm ⁻³	0-70	15	Level 2 Solar
Water Vapor Concentration	Validated Stage 2	cm ⁻³	0-70	20	Level 2 Solar
Ozone Concentration	Validated Stage 1	cm ⁻³	0-70	5	Level 2 Lunar
Nitrogen Dioxide Concentration	Provisional	cm ⁻³	0-70	15	Level 2 Lunar
Nitrogen Trioxide Concentration	Provisional	cm ⁻³	0-70	15	Level 2 Lunar

*RELEASE STATUS DEFINITIONS

Validated Stage 2 - Product uncertainty is estimated over a significant set of locations/time periods by comparison with suitable reference data. Results are published in the peer-reviewed literature.

Validated Stage 1 - Product uncertainty is estimated using a small number of independent measurements obtained from suitable reference data.

Provisional - These data are partially validated and improvements are continuing; quality may not be optimal since validation and quality assurance are ongoing.

Research - Suitable for validation, potentially usable for science and publications. Users cautioned.

Beta - Products intended to enable users to gain familiarity with the parameters and the data. Comment to the SAGE III team is appreciated.

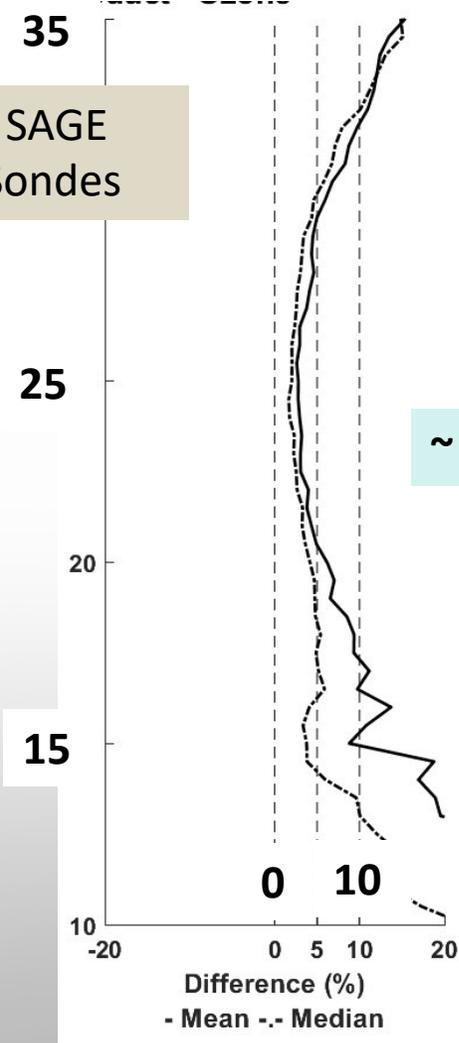


Ground-based Correlative Measurements Help Assess Algorithm Improvements



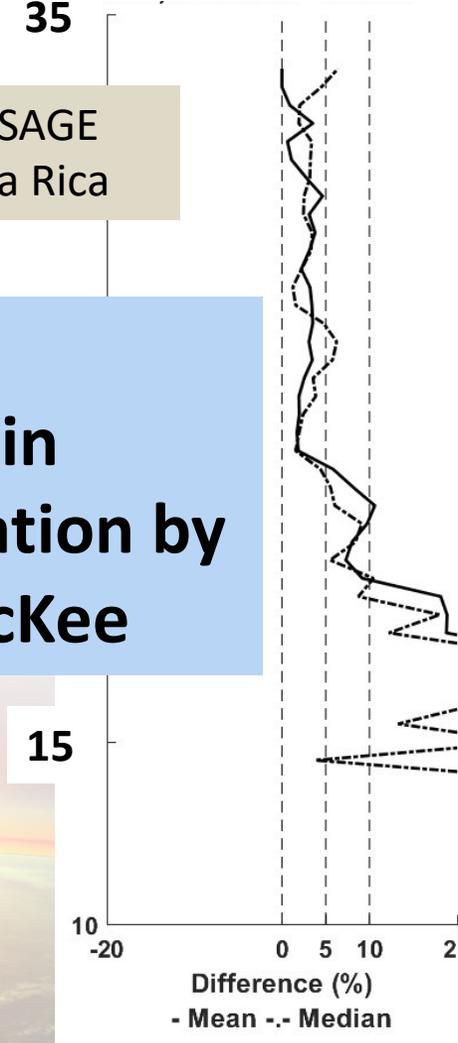
Ozone: SAGE vs. All Sondes

ALTITUDE [km]



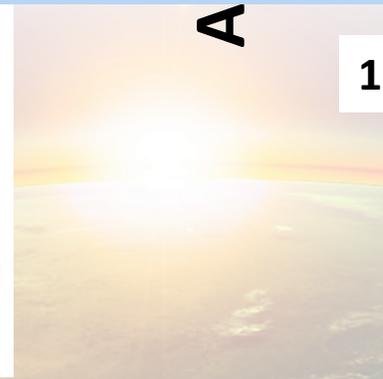
Ozone: SAGE vs. Costa Rica

ALTITUDE [km]



~ 5%

More details and improved graphics in validation presentation by C. Roller & M.C. McKee



➤ Thanks for using the [validation website](#) to improve coincidences.



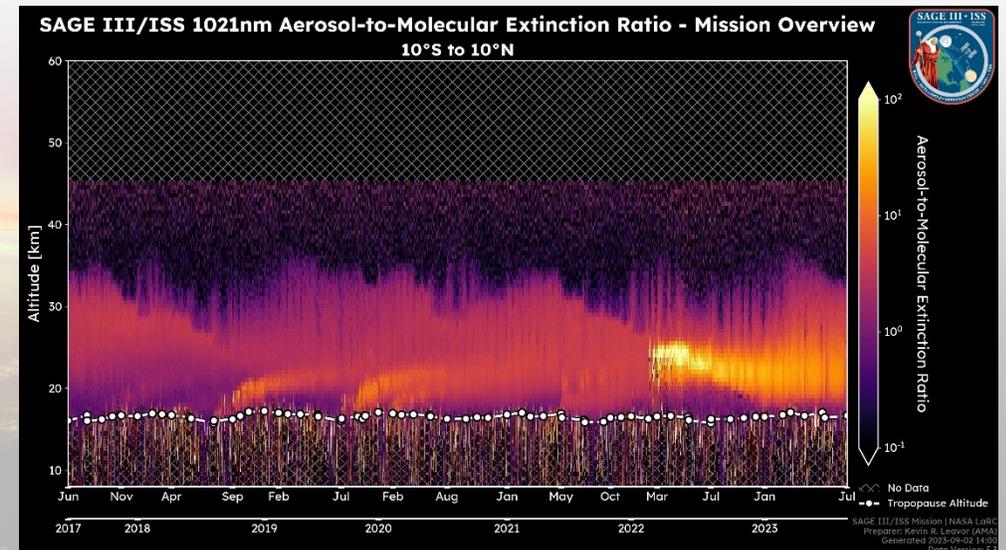
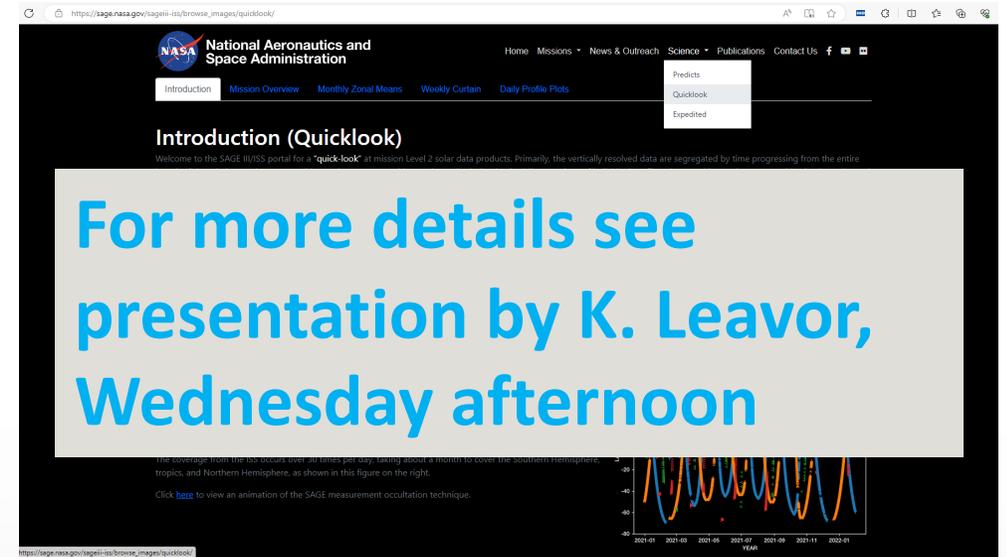
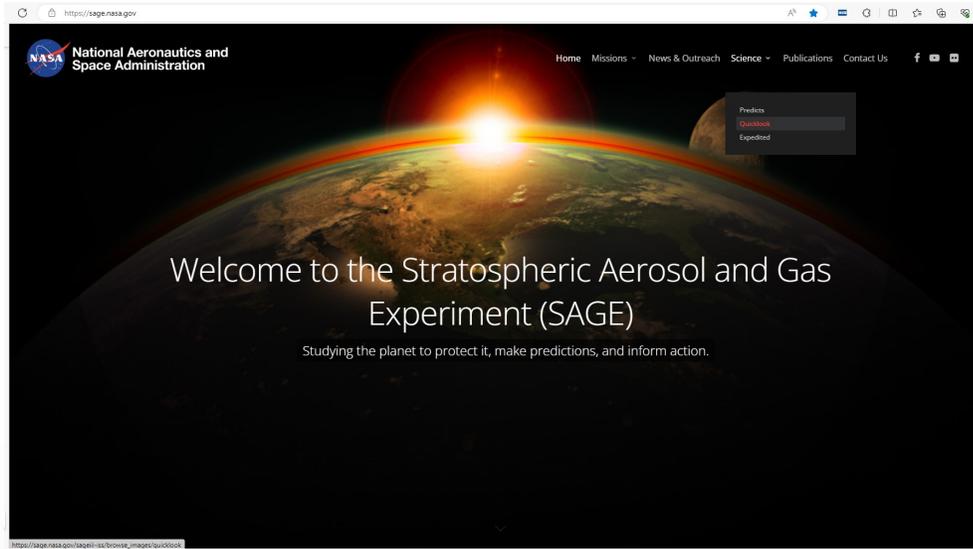
Interns



- **NASA Internship and Fellowship opportunities: [NASA Intern](#)**
- **SAGE III/ISS has a vibrant & sought-after internship program**
 - Typically 5 interns/yr during summer
- **Interns work on real tasks benefiting the SAGE III/ISS mission**
- **Fantastic program teaching necessary skills/habits for successful science/engineering careers, e.g.:**
 - Python programming
 - Configuration management (git)
 - Self documenting code techniques
 - Linux shells and scripting
- **Always looking for exceptional candidates – Dr. Charles Hill**



Quicklook Portal



- Chiefly architected by Danny Mangosing and Kevin Leavor
- Sadly, Danny passed away July 4, 2023
 - Fantastic contributor to many LaRC science missions
 - [Recent article about Danny](#)





Contamination Monitoring Package Data



- Data from the Contamination Monitoring Package (CMP) is available for NASA approved users via the Materials and Processes Technical Information System ([MAPTIS](#))
 - Satellite Contamination and Materials Outgassing Knowledgebase

https://maptis.nasa.gov/Home

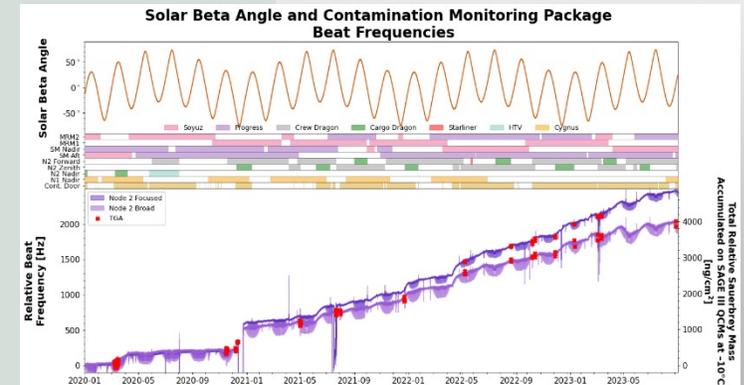
MAPTIS

Materials And Processes Technical Information System

Home Features About Register Sign In

International Space Station (ISS)

Welcome to the Materials and Processes Technical Information System (MAPTIS) Web Site. The goal of MAPTIS is to provide a single-point source for materials properties for NASA and NASA associated contractors and organizations. MAPTIS contains physical, mechanical and environmental properties for metallic and non-metallic materials.





Publications Using SAGE data



https://sage.nasa.gov/publications/

NASA National Aeronautics and Space Administration

Home Missions News & Outreach Science Publications Contact Us

SAGE III aerosol extinction validation in the arctic winter: Comparisons with SAGE II and POAM III 2007

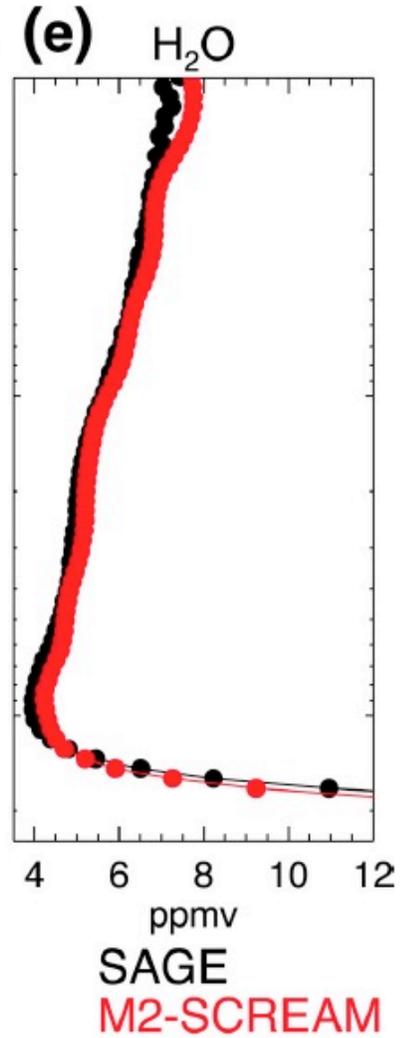
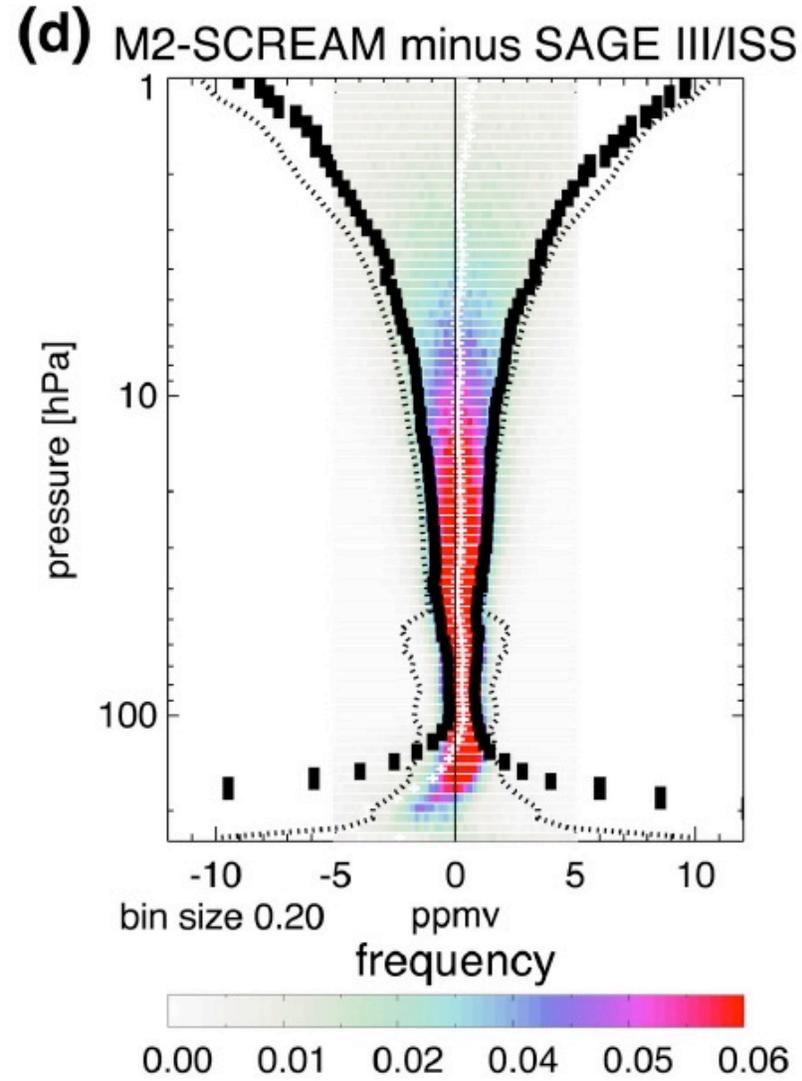
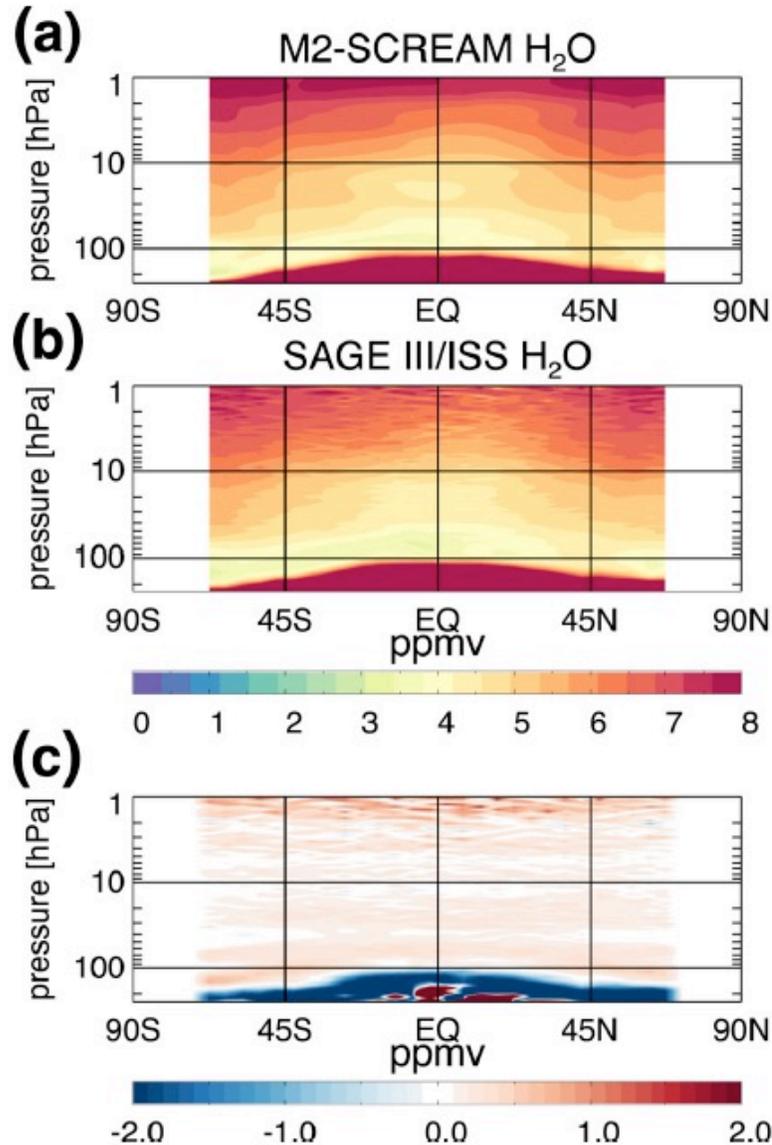
SAGE III on ISS

Search

Author	Title	Year
F. Wrana, U. Niemeier, L. W. Thomason, S. Wallis, C. Savigny	Stratospheric aerosol size reduction after volcanic eruptions	2023
L. W. Thomason, T. N. Knepp	Quantifying SAGE II (1984–2005) and SAGE III/ISS (2017–2021) observations of smoke in the stratosphere	2023
P. Sellitto, R. Belhadji, J. Cuesta, A. Podglajen, B. Legras	Radiative impacts of the australian bushfires 2019–2020 – part 2: Large-scale and in-vortex radiative heating	2023
P. Bernath, C. Boone, A. Pastorek, D. Cameron, M. Lecours	Satellite characterization of global stratospheric sulfate aerosols released by tonga volcano	2023
Adam E. Bourassa, Daniel J. Zawada, Landon A. Rieger, Taran W. Warnock, Matthew Toohy, Doug A. Degenstein	Tomographic retrievals of Hunga Tonga-Hunga Ha'apai volcanic aerosol	2023
M. Kovilakam, L. Thomason, T. Knepp	SAGE III/ISS aerosol/cloud categorization and its impact on GloSSAC	2023
Hsiang-He Lee, Katherine A. Lundquist, Qi Tang	Pyrocumulonimbus events over British Columbia in 2017: An ensemble model study of parameter sensitivities and climate impacts of wildfire smoke in the stratosphere	2023



A few favorites



- Kovik
- SAGE
- Boura
- Tomc
- aeros
- Warg
- M2-S
- data
- Send



ESD Senior Review 2023 – SAGE submission



- Submitted April 2023
- No pre-Covid this time, but still had to balance work & life
- Fantastic team effort by Science, Operations & Engineering
- 109 pages, including covers
- Used GitHub and latex for a much improved experience over last time with M\$W

SAGE III ISS
Stratospheric Aerosol & Gas Experiment

Proposal to the Senior Review
2023 for Extension of Earth
Science Operating Missions

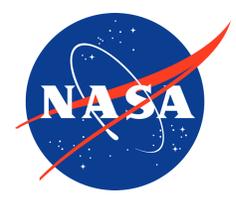
David Flittner, Project Scientist
Marilee Roell, Science Manager
NASA Langley Research Center

Altitude [km]

2018 2019 2020 2021 2022 2023

PNW PyroCb, Ambae, Raikoke, Australian PyroCb, Ulawun, La Soufrière, Hunga Tonga-Hunga Ha'apai, Fukutoku-Okino-Ba

SAGE.NASA.GOV



SAGE Senior Review Themes



- SAGE datasets are notable for their inherent stability derived from the occultation technique.
- SAGE uniquely provides geophysical reference standards for vertically resolved stratospheric concentrations of ozone, water vapor, nitrogen dioxide, and multi-wavelength aerosol extinction coefficient.
- These can be used in validating datasets from new methods and future instruments, detecting erroneous biases/trends in contemporaneous datasets, and validating constituent assimilation.
- SAGE yields the only space-based direct measurement of stratospheric aerosol optical depth in the solar-reflective regime, a primary parameter for climate predictions/modeling.
- SAGE III/ISS is the youngest sensor among the select few instruments producing demonstrated trend-quality trace gas data —by 13 years for water vapor.
- The mission expects science operations can continue beyond FY29.
- SAGE III/ISS is in an excellent position to extend the uniquely valuable science records throughout this decade, improve their quality and bridge to future missions.



Budget



- **Still awaiting official guidance from NASA Earth Science Division**
 - Review committee report may appear before official letter
- **FY2023 unexpected mid-year reduction ~15%**
- **FY2024-> ESD guidance is ~33% cut relative to prior projections**
- **SAGE submitted Senior Review over-guide attempts to balance in-guide and prior projections**
- **Unable to directly fund sonde-based validations☹️**



Future of SAGE III/ISS



- **Continue collecting/processing/distributing SAGE III/ISS science data products**
- **Continue addressing known deficiencies in existing data products**
- **Continue evaluating existing products**
- **Release new and research products**
 - Level 3 Aerosol/Cloud Flag
 - O₂ A-band T/p profiles
 - Limb scatter L1b
- **Pace of activities governed by available budget**
- **NASA claims ISS will be de-orbited in 2031.**



Limb Scatter Data



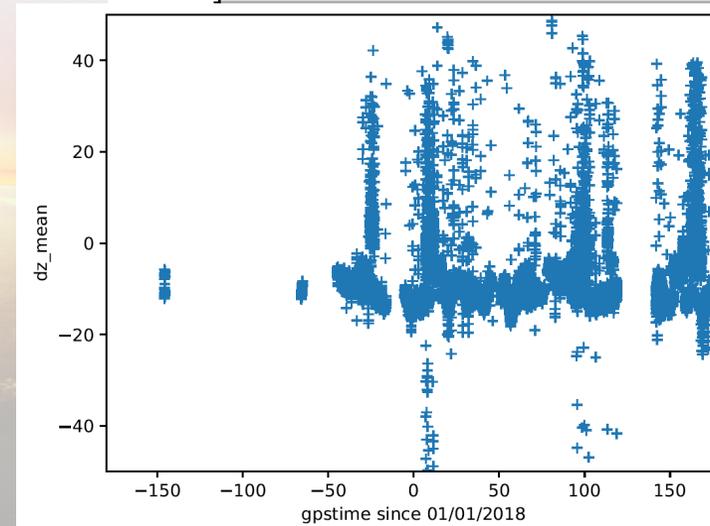
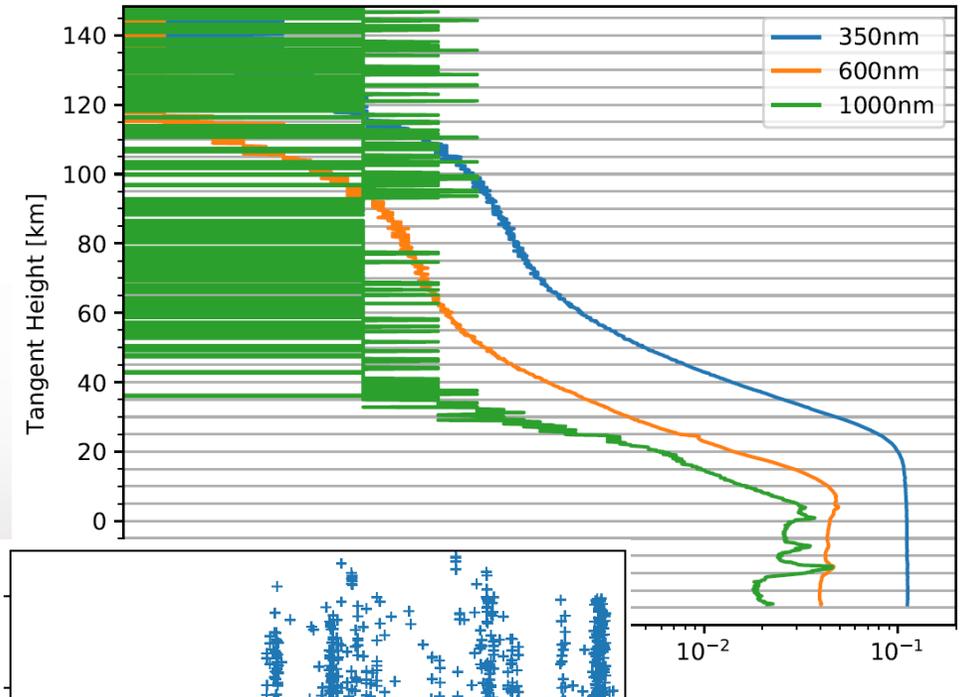
➤ Maturity of Limb L1 product greatly improved Fall-22/Spring-23 by Emma McIntyre (Columbia U.)

- Correction for dual ISS attitude solutions
- Ephemeris interpolation – flag
- Processing meta-data
- RSAS attitude estimate w/ std. atmosphere

➤ Future work:

- Correlate RSAS correction with Off-nadir angle from Disturbance Monitor Package
- Disturbance Flag derived from recent solar occultation work
- Multi-wavelength stray light estimate

Scan 2: Lon 64.55, Lat 13.63, Mean dz applied -6.1980

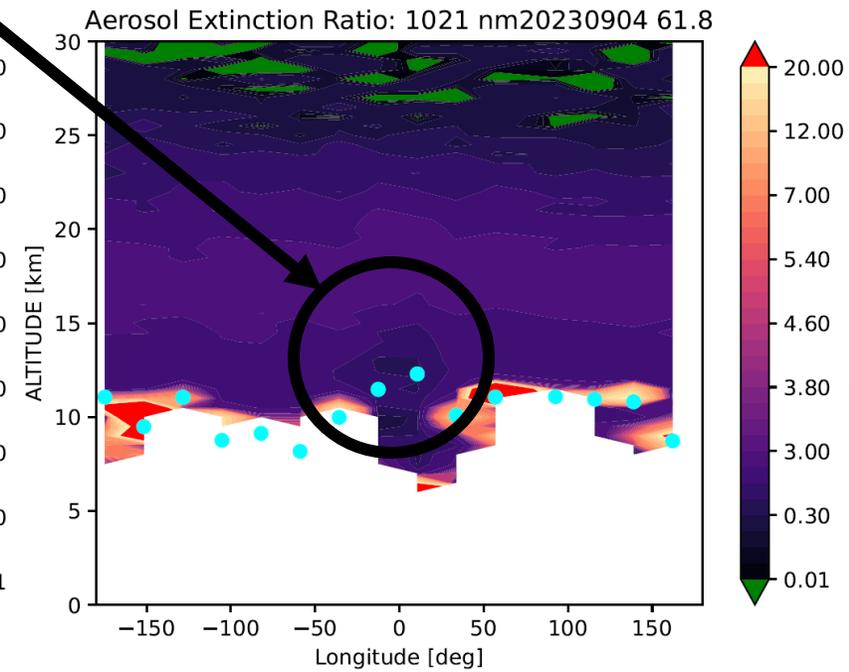
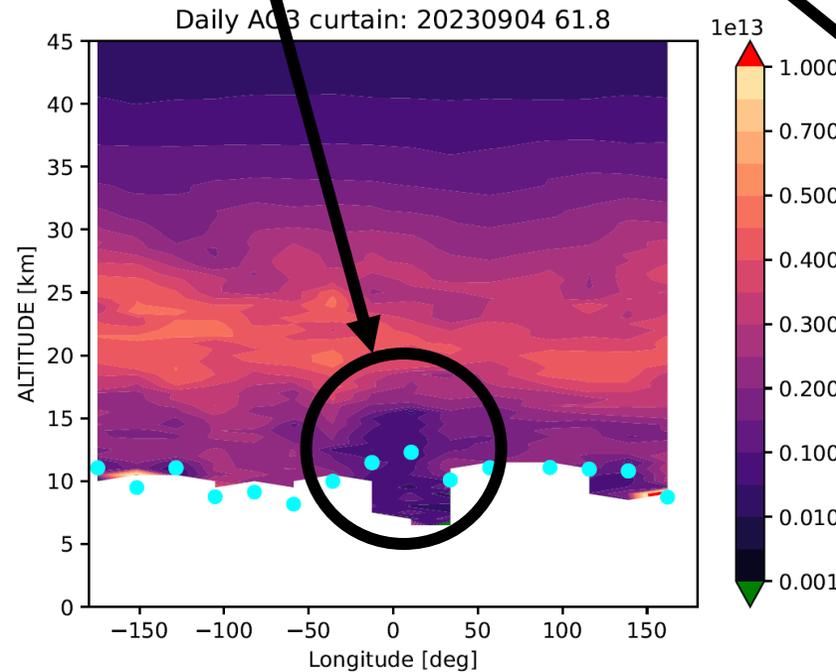
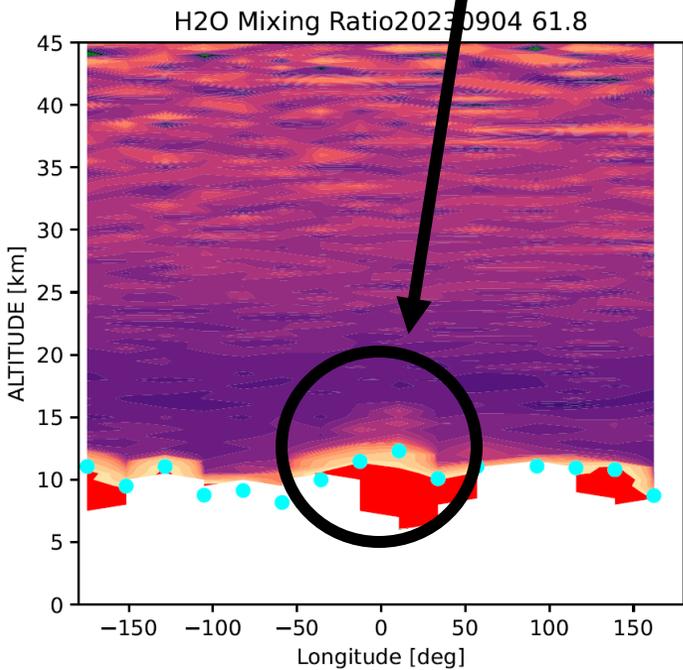




SAGE III/ISS – Sept. 4, 2023 @ 62N



- Signatures of Trop./Strat. exchange near ~ 10 East, @ 15 km
- Enhanced WV, decreased ozone & aerosol





2023 Summary



- **SAGE III/ISS mission has completed 6+ yrs of collecting, processing, releasing & evaluating occultation data products**
- **Mission released timely update of data products – v5.3**
- **Products are updating popular databases, providing geophysical reference standards and illuminating stratospheric processes**
- **Continued science intern opportunities**
- **Increased data accessibility via Quicklook portal**
- **Awaiting results of proposal to 2023 ESD Senior Review**
- **SAGE III/ISS is in an excellent position to extend the uniquely valuable science records throughout this decade, improve their quality and bridge to future missions.**